

D cket No. YAMAP0800USSerial No. 10/079,269**REMARKS**

Upon entry of the present Reply, claims 1-3 and 5-19 are pending in the application. Claims 1 and 14 are amended, and claim 4 is cancelled, herein. Support for the amendment of claim 1 may be found in originally filed claim 4. Claim 14 is amended to correct its dependency to claim 2. Favorable reconsideration in light of the amendments and the remarks which follow is respectfully requested.

Applicants respectfully submit that the claims, as amended, fully distinguish the present invention over the prior art, and particularly over the reference cited and relied upon in rejecting Applicants' claims in the Office action to which this Reply is responsive. Applicants respectfully submit that the presently claimed invention would not have been obvious over the cited reference. Applicants respectfully request reconsideration and withdrawal of the rejections of the claims of the present application.

Rejections Over Udagawa.

Claims 1-19 stand rejected as obvious over U.S. Patent No. 6,541,797 to Udagawa. Regarding claims 1, 4, 12, 13 and 16-19, the Examiner contended that Udagawa discloses a process for the growth of GaInN layers in which the concentration of In varies between the layers. The Examiner contended that the sole difference between the instant claims and the prior art is the varying of the In source gas. The Examiner contended that, in the absence of unexpected results, it would have been obvious to vary the In concentration by varying the In source gas in the Udagawa method to achieve the desired concentration and control over the concentration in each layer.

With respect to claims 2, 3, 5-11, 14 and 15, the Examiner contended that providing additional layers by the same process would have been obvious for the same reasons as would the base claim.

Udagawa discloses in, e.g., Fig. 11, a GaInN layer 102a of $\text{Ga}_{0.85}\text{In}_{0.15}\text{N}$ having a fixed In composition ratio, and a GaInN layer 102c of $\text{Ga}_{0.88}\text{In}_{0.12}\text{N}$. See, e.g., col. 22, lines 61-66. The apparatus 90 for forming these layers is described from col. 13, line 42 to col.

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14, line 51. Udagawa mentions, at col. 13, lines 19-25, that the group-III nitride semiconductor can be formed by MOCVD, MBE or VPE. However, while Udagawa mentions MBE, Udagawa discloses and enables only MOCVD. The primary focus of Udagawa is obtaining an abrupt junction interface of the group-III nitride semiconductor. This is achieved by providing a special sweep-gas channel, by which the MOCVD reactants can be rapidly and completely swept out of the reaction chamber upon completion of a layer deposition step. The methods disclosed by Udagawa as necessary to obtain the abrupt junction, including the use of a sweep gas, are not applicable to the high-vacuum environment used for MBE. Udagawa does not disclose or suggest how the goal of an abrupt junction might be obtained by MBE.

Furthermore, the use of a sweep gas as in Udagawa is incompatible with the presently claimed step of varying the rate of supply of indium to form the respective layers. Udagawa teaches the use of a sweep-gas to sweep out the reactants. This would significantly complicate the process and the teaching thereof would not lead a person of ordinary skill to Applicants' claimed invention in which the transition from layer to layer is carried out by varying the rate of supply of indium to the growth chamber.

MBE is carried out in a high vacuum environment, and an ultra-high vacuum environment is typically used for the growth of (In,Ga)N layers, typically around 10^{-3} Pa (see, e.g., page 2, lines 12-15 of the present specification). In contrast, MOCVD is generally carried out at atmospheric pressure or just below, typically around 10 kPa (see p. 1, line 23 to p. 2, line 1 of the present specification) and col. 23, lines 41-42 of Udagawa). Because of this and the many other differences between the process disclosed by Udagawa and the presently disclosed and claimed invention, a person of skill in the art would not have been motivated to make the numerous modifications to the method of Udagawa which would be necessary to use MBE as in the present invention.

Furthermore, MBE does not use metal-organic precursors, such as those disclosed by Udagawa at, e.g., col. 23, lines 54-57 and col. 25, lines 22-23. MBE uses metal targets heated by, e.g., an electron beam, to evaporate the metal to produce the molecular beam.

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Thus, at best, Udagawa provides an invitation to experiment, or an "obvious to try" situation with respect to MBE. As is well known, "obvious to try" is not the standard for determination of obviousness.

Accordingly, in the Office Action the Examiner failed to state a *prima facie* case of obviousness, since Udagawa fails to disclose all the limitations of Applicants' claimed invention. Specifically, although Udagawa mentions MBE, there is no suggestion in Udagawa of any possible way to modify the MOCVD method disclosed by Udagawa which would lead a person of skill in the art to Applicants' invention as claimed. There is no basis in Udagawa, and no motivation or suggestion, to make the extensive modifications to the disclosed method which would be necessary if a person attempted to change from the MOCVD disclosed by Udagawa to the presently disclosed and claimed MBE method. There can be no reasonable expectation of success in changing from MOCVD to MBE. Thus, there is no *prima facie* obviousness.

Furthermore, claim 1 has been amended to recite that the substrate temperature during the growth of the at least one InGa_N layer is in the range from 650°C to 800°C, as was originally recited in claim 4. In rejecting claim 4, the Office Action did not address the upper limit of 800°C for the formation of the InGa_N layer(s). This feature further distinguishes the presently claimed invention from the disclosure of Udagawa. Udagawa clearly states that the Ga_N layer is normally formed at about 1100°C, and that InGa_N layers are normally formed between 800°C and 900°C (col. 3, lines 31-45). In addition, Udagawa discloses that the MOCVD process disclosed therein is carried out at a temperature between "around 800°C to 1200°C" (col. 13, lines 31-33). In the examples, Udagawa discloses formation of InGa_N layers at 890°C (col. 23, lines 44-54 and col. 25, lines 20-42). Thus, the presently pending claim 1 further distinguishes over Udagawa for this reason.

With respect to claim 16, which recites that each layer is grown at substantially the same temperature, this feature is not disclosed in Udagawa. The advantage of this feature is that the quality of the layers is improved because there is no interruption of the growth

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process between layers (p. 12, lines 6-11 of the present specification). Applicants are aware of no suggestion in Udagawa that the growth temperatures should be the same for each layer. In fact, Udagawa discloses a wide range of temperatures. While the Examiner contended that a person skilled in the art would be able to find the optimum growth conditions, this is just one more modification which is neither disclosed nor suggested in Udagawa.

Rejection of Claim 14 as Indefinite

Claim 14 has been amended to correct its dependency from claim 1 to claim 2. Accordingly, Applicants respectfully submit that the rejection of claim 14 as indefinite is overcome and should be withdrawn.

Conclusion

Applicants respectfully submit that the claims, as amended, fully distinguish the present invention over the prior art, and particularly over the references cited and relied upon in rejecting Applicants' claims in the Office action to which this Reply is responsive. Applicants respectfully submit that the presently claimed invention is neither anticipated by, nor would have been obvious over, the cited references, either taken alone or in any of the myriad asserted combinations. Applicants respectfully request reconsideration and withdrawal of the rejections of the claims of the present application. For all the foregoing reasons, Applicants respectfully submit that the claims are now in condition for allowance and request the examiner to indicate such.

In the event issues remain in the prosecution of this application, Applicants request that the Examiner telephone the undersigned to expedite allowance of the application. Should a Petition for Extension of Time be necessary for a timely reply to the outstanding Office action (or if such a petition has been made and an additional extension is necessary) petition therefor is hereby made and, if any additional fees are required for the

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filing of this paper, the Commissioner is authorized to charge those fees to Deposit Account #18-0988, Docket No. YAMAP0800US.

Respectfully submitted,
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